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PERTINENT INFORMATION ABOUT THE BLACK-HEADED BUDWORM IN THE NORTHERN ROCKY MOUNTAINS

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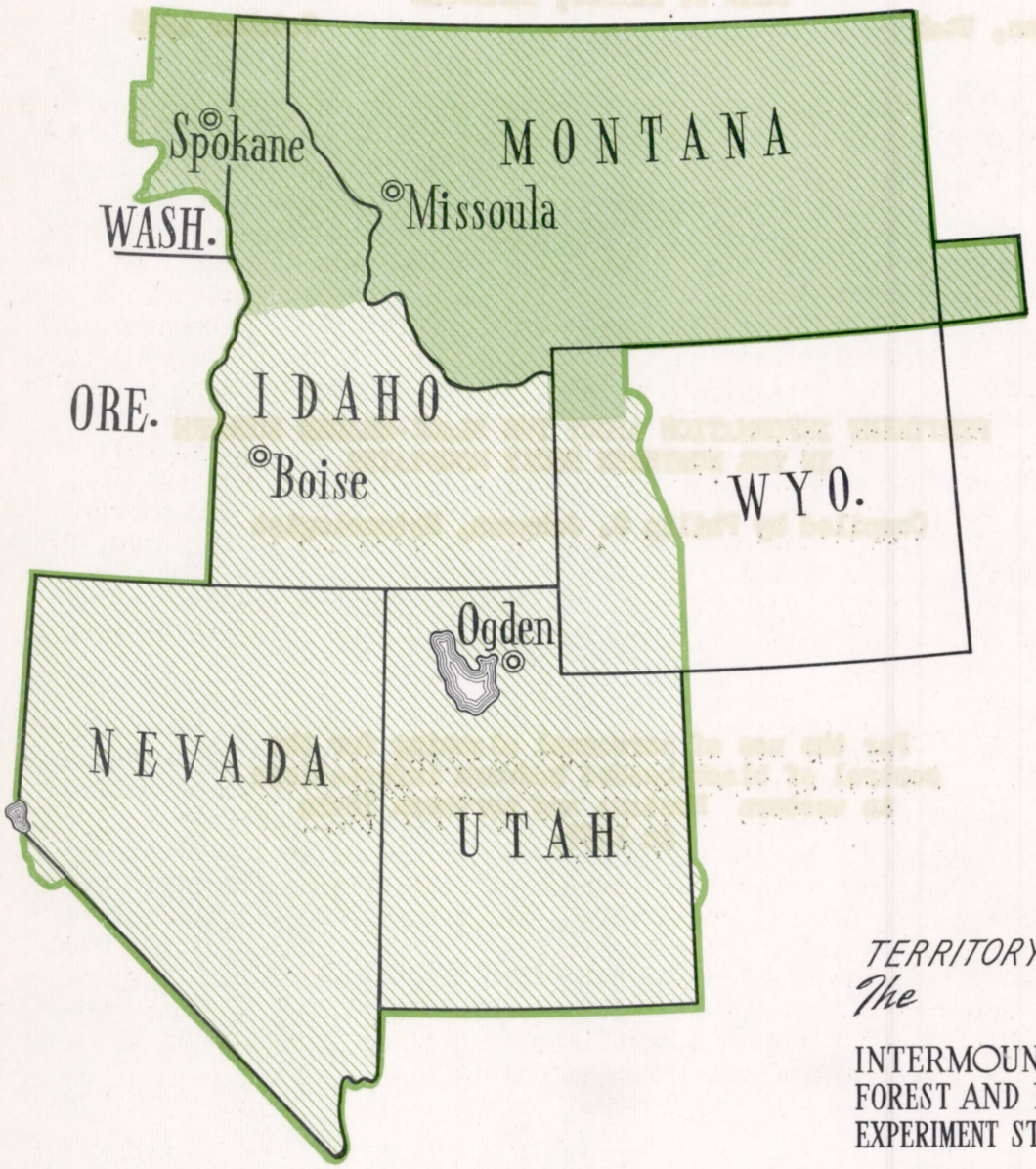
For the use of personnel planning for the control of black-headed budworm infestations in western Montana and northern Idaho in 1957.

Prepared by the
Missoula Forest Insect Laboratory
Missoula, Montana

The AREA COVERED BY THIS REPORT



TERRITORY OF The INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION

The MISSOULA FOREST INSECT LABORATORY is a field unit of the Intermountain Forest and Range Experiment Station at Ogden, Utah. The Laboratory conducts forest insect research, surveys forest insect outbreaks, and gives technical advice on cooperative insect control programs in Montana, northwestern South Dakota, northwestern Wyoming, northern Idaho, and northeastern Washington.

The functions are conducted in the remaining station territory by staff entomologists at Ogden, and Boise, Idaho.

PERTINENT INFORMATION ABOUT THE BLACK-HEADED BUDWORM IN THE NORTHERN ROCKY MOUNTAINS[1]

OUTBREAK HISTORY

Epidemic infestations of the black-headed budworm, Acleris variana Fern., have occurred several times during the past two decades in an area extending from the Olympic Peninsula, coastal British Columbia including Vancouver Island, to southeastern Alaska. A severe outbreak of this insect covered approximately 140,000 acres of western hemlock forests in the Olympic Peninsula in 1929 (3) and in 1943 and 1944 another outbreak covered about 200,000 acres in the same area and southward in a narrow belt along the coast to the Columbia River (2). Outbreaks have occurred at irregular intervals in southeastern Alaska for many years, the first recorded in 1919. The most recent occurred in 1948 on the Tongass National Forest and reached its greatest extent in 1953 when it spread over the entire Forest, an area of 16,073,000 acres (6). About 10 percent of the infested hemlock trees were killed, many of the remainder being top-killed. An epidemic of black-headed budworm was reported on the northern part of Vancouver Island in 1952 and, by 1955, had spread over 1,600 square miles causing complete stripping of foliage from the upper 10 feet of many trees and heavy loss of foliage from the remainder of the crowns (8). Further defoliation was expected in 1956.

Three black-headed budworm outbreaks have been recorded in the northern U. S. Rockies prior to 1956. In 1928-29 an outbreak was reported on alpine fir and Engelmann spruce in Bechler Basin, Yellowstone National Park, Wyoming by Balch (1). In 1948 an outbreak was reported on 3,000 acres of alpine fir on the Kootenai National Forest in northwestern Montana. Immediate plans to control it in the caterpillar stage proved unnecessary when the entire budworm population suddenly succumbed to natural control agents. An epidemic infestation of black-headed budworm caused serious defoliation but little initial tree mortality on 19,200 acres of alpine fir in Yellowstone National Park in 1955 and 1956 (10)(11). The entire caterpillar population succumbed in 1956 with symptoms of polyhedral virus infection.

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[1] The use of unpublished observations by R. E. Balch, A. J. Jaenicke, R. L. Furniss, M. L. Prebble, K. Graham, W. F. McCambridge, G. R. Struble, Tom T. Terrell, Harold R. Dodge, and David McComb, whose reports are herein cited or who furnished verbatim information, is gratefully acknowledged.

In 1956, two black-headed budworm infestations caused very heavy defoliation of western hemlock, with the possibility of ultimate tree mortality in younger trees, at widespread localities in Montana. One of these covered 12,500 acres in parts of the Kaniksu National Forest in northern Idaho and the adjoining Kootenai National Forest in western Montana (13). A second infestation caused similar damage on 5,000 acres in the most heavily travelled portion of Glacier National Park (12). Aerial and ground surveys in 1956 also disclosed small localized current outbreaks of the worm associated with spruce budworm (Choristoneura fumiferana (Clem.)) infestations north of Ennis, Montana and near Woodward Point in the Swan River Valley, Montana.

The history of past black-headed budworm outbreaks indicates several common characteristics: (1) each has subsided naturally and without resort to applied control measures, (2) the duration of outbreaks has been from 1 to 5 years, (3) tree mortality resulting from budworm-caused defoliation has not been significantly great, but the top-killing and consequent stem deformity and the increment reduction has been considerable, and (4) the heavy feeding and resultant dead and webbed needles clinging to the infested trees constitutes a serious forest fire hazard.

THE INSECT

The black-headed budworm is a moth belonging to the family Tortricidae of the order Lepidoptera to which order belong all moths and butterflies.

The moth is the adult form of the 4-stage metamorphosis common to most insects. It is grey or brownish with mottled white wings. It has a wing expanse of 3/4 inch. The eggs are yellow, flattened and oval in shape and slightly less than 1 mm. (1/25 inch) in length. The larvae, or caterpillars, are mostly yellow to yellow-green with a shiny black head while young (instars 1-4), but with a tan to orange head later (5th instar). When fully grown they are about ½ inch long and bright green in color. McCambridge's work (5) indicates 5 larval instars. The pupae are mottled greenish-brown and about 3/8 inch long.

HOSTS

In the northern Rocky Mountains the recorded hosts of the black-headed budworm are western hemlock (Tsuga heterophylla), alpine fir (Abies lasiocarpa), and Rocky Mountain Douglas-fir (Pseudotsuga menziesii var. glauca (Beissn.) Franco.

LIFE HISTORY

The life history of the black-headed budworm has not been precisely determined in the northern Rocky Mountain region of the United States. Cursory observations indicate that it is similar to that in the Pacific Northwest with minor variation in the timing of development. The budworm passes through the winter in the egg stage. These hatch in late May and early June coincident with the opening of the hemlock or fir buds. The caterpillars persist until the middle or end of August. In 1956 at Glacier National Park caterpillars pupated during the entire month of August. Pupae were found during August and early September. Moths appeared the end of August and continued to appear in September. Eggs were laid in September and early October to complete the one-year life cycle.

HABITS

Following mating the female moths deposit eggs singly usually on the lower surface of the hemlock or fir needles. As the host tree buds begin to swell in the spring, the eggs hatch and the tiny caterpillars mine the inside of the buds. Many buds are believed to be completely destroyed before they open and the enclosed needles begin to expand. When this occurs, the caterpillars responsible for this condition will move to another bud. After the buds open and needle growth continues, the caterpillars each web a few needles together and feed upon them while inside this protective covering. Such feeding usually lasts about 6-7 weeks in Alaska (McCambridge) and presumably for a similar period in the northern Rockies.

Pupae are formed in needles webbed together by the caterpillars prior to pupation. Three weeks are spent as pupae.

The flying moths mate and die after the females have deposited their eggs. Little is known of the moth flight habits.

TREE DAMAGE

First-year damage from light budworm populations may result in only the loss of some of the current season's needles. Heavier feeding by larger populations may destroy all current needles and some of the older needles with resultant killing of from 1 to 3 feet of the extreme tops of the infested trees.

Budworm feeding in successive years may increase the amount of overall defoliation and the amount of tree top-killing. Mortality of some younger trees may also occur.

The initial effects of budworm defoliation are the loss of increment and the deformity of top-killed trees. The ultimate effect of continued budworm defoliation may be tree mortality.

A residual effect of severe defoliation is the severe fire hazard created in the hemlock forests by the abundance of dead and dying needles, dead twigs, and silken webbing. This material is highly flammable during periods when the fire danger rating is high.

McCambridge has shown that a correlation exists between the number of eggs deposited per lineal inch of twig and the severity of defoliation the following summer. An average of 0.1 eggs or less per twig-inch apparently will produce budworm populations light enough to cause only insignificant defoliation. An average of 0.27 eggs per twig-inch, however, will cause general browning of the foliage in the upper crowns of open-grown hemlock reproduction.

He also pointed out that egg deposits were much greater in the upper third of the crowns of open-grown hemlock reproduction in southeastern Alaska.

NATURAL CONTROL

One of the most effective natural control agents of the black-headed budworm is disease. A polyhedral virus and a fungus, Empusa grylli (Fres.) Nowak, were found by McCambridge to be responsible for the termination of budworm outbreaks in southeastern Alaska. Virus disease is also reported by Prebble and Graham (7) as an effective control factor in the sudden decline of infestations on Vancouver Island and by Struble (9) in stopping an epidemic on the Olympic Peninsula. A virus was also the prime factor believed responsible for termination of the budworm outbreak in Yellowstone National Park in 1956 (11).

Insect parasites are known to be effective in controlling budworm populations on the Pacific Coast but no information is available concerning their effectiveness in the northern Rockies.

In almost every instance black-headed budworm infestations in the western United States and Canada have subsided from natural causes and applied control measures have never been used.

CHEMICAL CONTROL

McCambridge conducted field tests to show that a 6.25 percent DDT emulsion was 100 percent effective in killing 3rd instar black-headed budworm caterpillars; also that a 6.25 percent DDT-oil solution was equally effective against both 3rd and 4th instar budworm larvae when applied at a dosage of 0.52 pounds per acre.

From this study it is evident that, with but slight modification, the standard technique used to control other forest insect defoliators may be used to control the black-headed budworm in the northern U. S. Rockies. This would involve the use of an aerially applied DDT-oil insecticide to the infested hemlock forests during the 3rd and 4th caterpillar instar.

The recommended insecticide formulation is as follows:

DDT[2/], technically pure	1	pound
Auxiliary hydrocarbon solvent	1.25	quarts
#2 fuel oil, to make	1	gallon at 60°

The above mixture should be applied in the form of a fine spray from airplanes or helicopters at the rate of 1 gallon per acre of infested forest. The spray particles should be between 50 and 300 microns in diameter with an average size of 150 microns. The spray is released from aircraft flying between 200 and 400 feet above the tree tops in quiet, dry, cool air. Wind velocities of the air during spraying should not exceed 6 miles per hour; air temperatures should not exceed 68° F. Foliage should be dry when spray is deposited. This combination of factors ordinarily requires aerial spraying to be done from 4:00 a.m. to about 9:00 a.m.; probably during July. The above dosage of DDT normally kills 95% or more of the budworm population in any given area if properly applied.

The DDT insecticide applied at the rate of one pound or one gallon per acre is harmless to most all fish, birds, and domestic or wild mammals in the sprayed forest environment. It is also harmless to human beings at this dosage. A high proportion of terrestial and aquatic insects that contact the spray, however, may be killed and sprayed areas are often insect-free for several weeks following spraying. Domestic honeybee colonies must therefore be removed from the budworm-infested areas prior to spraying or covered for several days during and immediately following the spraying.

ADDITIONAL INFORMATION

Additional information concerning the black-headed budworm and its control in this region may be had by contacting the Missoula Forest Insect Laboratory, U. S. Forest Service, 3013 Federal Building, Missoula, Montana. Telephone Missoula 2-2131. If damage as described is noted in areas other than those mentioned the Laboratory would appreciate the information.

2/ p,p[1]-Dichlorodiphenyltrichloroethane.

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